Podium Presentations

Session III: Biodynamics I

Chairs: Douglas Reynolds and Farid Amirouche

PNEUMATIC ACTIVE SUSPENSION DESIGN FOR HEAVY VEHICLE SEATS AND OPERATOR RIDE COMFORT

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Introduction

Handling of heavy vehicles such as tractors, trucks and buses require a large roll stiffness which causes large high accelerations at the seat level during impacts. To provide comfort and minimize the energy transfer from the chassis and the seat a pneumatic active seat suspension is proposed. An active seat suspension design and control algorithm under development at the University of Illinois at Chicago, UIC, is being developed and tested. Preliminary results are presented in this paper.

The design of a passive suspension typically consists of optimizing the value of two parameters: the stiffness and the damping of the suspension. The general dynamic performance of the suspension is limited to the conditions under which these parameters were obtained. A change in the input conditions might lead to poor suspension and an amplification of the vibration transmitted to the body. The focus of this paper is a robust, semi-active suspension system with a variable controlled damping and using the body response an index measure to minimize the acceleration at the interface of the seat and operator.

A summary of existing suspensions, such as MR and ER fluids, and spring loaded and dual valve shock absorbent will be discussed to highlight the need of a semi-active pneumatic suspension system design.

Methods

A model of the proposed suspension was developed in MATLB (Simulink) and different control strategies for the valve position in relation to the cylinder pressure tested. The effects of stiffening and softening resulting from pressure changes in the cylinder were examined. The vertical accelerations of the seat was computed for different control strategies and configurations of the suspension and compared to the response of a passive seat suspension.

A lump -mass model was created to represent the human body including the head, the upper, middle and lower torso as well as the legs. The connective forces between body segments were modeled through modal analysis techniques from previous experiments at the Vehicle Technology Laboratory. ISO standards and absorbed power were used to evaluate the different configuration of the seat suspension system in relation to the dynamic response of the operator.

Results

Initial results of the semi-active suspension system show a significant reduction in the RMS value of the acceleration of the seat. A reduction of the total absorbed power by the operator is expected to provide an insight into the control strategies adapted in the active suspension.

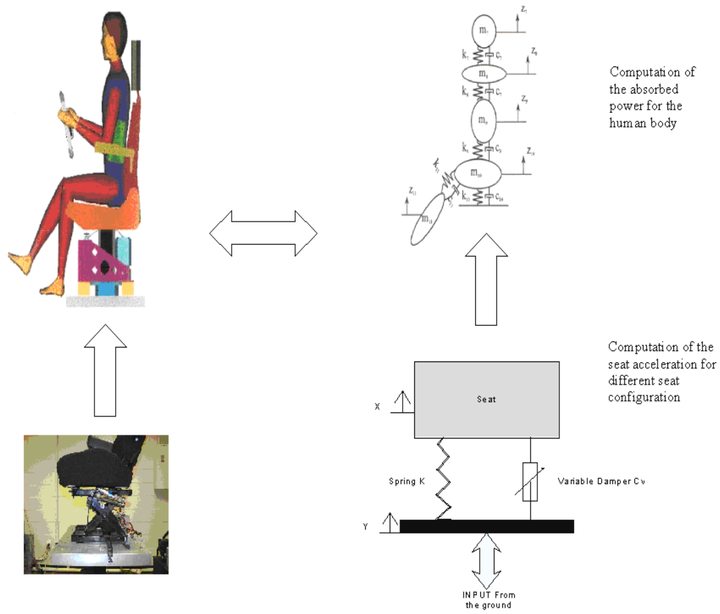

Figure 1 : Scheme of the general method applied in the study

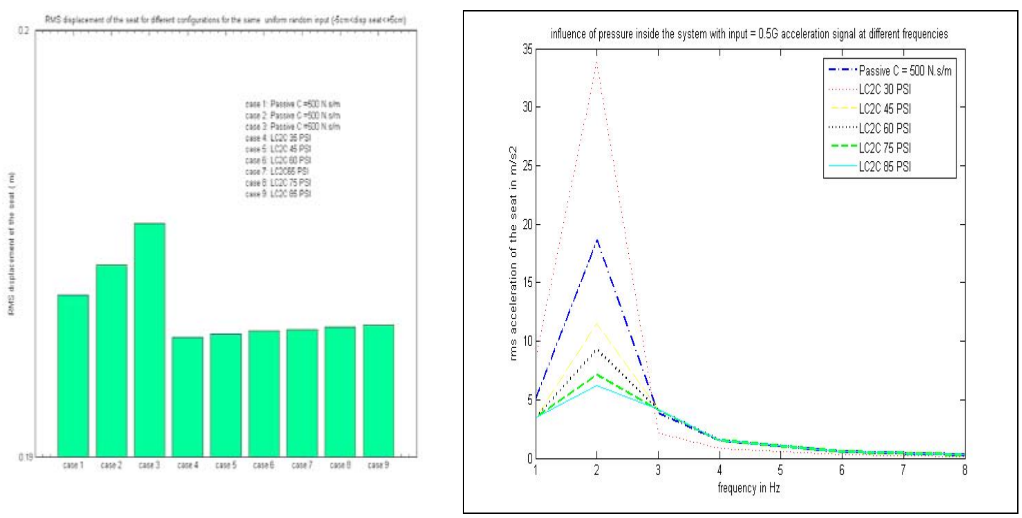

Figure 2 : RMS Acceleration of the seat for different configuration of the suspension

References

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